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ABSTRACT

This study examined the effectiveness of computer assisted instruction (CAI) in improving the mathematics achievement and academic self-confidence of black students in an Education Entrance Examination (EEE) seminar at a predominantly black college in South Carolina. Subjects were 49 students participating in the seminar, 43% black males and 47% black females. Students in the experimental group received 30 minutes of CAI in addition to EEE seminar instruction in mathematics given to both the control and experimental groups. Results of analyses of covariance indicated that EEE seminar students exposed to the CAI mathematics program scored significantly higher in basic skills mathematics and academic self-concept than the students who were not exposed to the CAI treatment. The results provide evidence that low SES students in the control group also increased their basic skills mathematics and academic self-concept scores, whereas high SES students neither increased nor decreased their scores significantly. (2 tables and 21 references) (EW)

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EFFECTS OF A COMPUTER ASSISTED INSTRUCTION EEE SEMINAR ON MATHEMATICS ACHIEVEMENT AND ACADEMIC SELF-CONCEPT OF STUDENTS AT A PREDOMINANTLY BLACK COLLEGE IN A RURAL COMMUNITY IN THE SOUTH

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Introduction

Testing prospective teachers in the basic skills is becoming standard practice for admission to a teacher education program. Since Blacks and other minorities, as groups, tend to score lower on standardized tests, fewer teachers from the present pool of these groups are likely to qualify for admission to teacher education programs. Consequently, future teachers from these groups could become vanishing breeds.

In some states, as is the case in South Carolina, state legislatures would have to amend existing laws regarding teacher education admission requirements and grant approval to colleges and universities to use alternative teacher education admission requirements. Despite barriers, continuous efforts must be made to ensure that the teaching profession reflects the racial and cultural diversity which has made America great.

Teacher-training programs at Predominantly Black institutions (PBIs) have been severely affected by the teacher testing movement of the past decade (Cross, 1988). These programs, which in the past have produced nearly half of all Black teachers are experiencing alarmingly high failure rates among their

graduates on teacher certification tests (Dilworth, 1986). The failure rate on teacher admission tests is also high. A typical response to these high failure rates has been to view these programs as somehow deficient. Indeed, at least six states have adopted policies that use passing rates on teacher certification tests for decisions regarding program approval, continuation, or funding of teacher-training programs (Witty, 1986).

In 1985, dynamic and multi-faceted initiatives were sphereheaded by Dr. Earline Simms to upgrade the Teacher-training programs at South Carolina State College. Dr. Simms provided leadership in the Teacher-training programs at Grambling College. Grambling is a PBI that has outstanding teacher-training programs. One such program focused on assisting students in passing the Teacher Education Admissions Test. Grambling now has a 100% passing rate on the state mandated teacher admissions test. Dr. Earline Simms instituted programs at South Carolina State College similar to those at Grambling.

One of the programs was a seminar in mathematics supplemented by a CAI mathematics program. Microcomputers with highly rated mathematics software

were introducted to supplement the seminar in October, 1988 to augment the passing rate of students on the EEE mathematics test.

Purpose of Study

The purpose of this study is to evaluate the effects of a computer assisted remediation program on basic skills mathematics achievement and academic self-concept of students in an EEE seminar at a predominantly black institution in a rural setting. In addition, the adjusted posttest scores in basic skills mathematics and academic self- concept between males/females and high/low socioeconomic status were explored with regard to type of instruction.

Theoretical Framework

The theoretical framework for the study consists of theories, concepts, and principles which explain the major variables in the study. The framework provides the context of the study, its rationale, and its significance. The ingredients for the theoretical framework come from analysis, synthesis, and evaluation of the literature and the researchers' insights into the problem. The foundation of the framework are the theories and principles which explain computer assisted instruction, computer assisted instruction and mathematics and academic self-concept.

Computer assisted instruction is based on the

assumption that personalized tutoring, immediate feedback-correctives, and frequent reinforcements are essential means for increasing achievement and self-concept (Mevarech & Rich, 1985). Academic self-concept is a relatively recent refinement (Brookover, Paterson, & Thomas, 1962) which has grown out of the more general theories of self-concept. The earlier idea of self-concept, an undifferentiated global construct, was comprehensive but overlooked the fact that individuals may view themselves multidimensionally. The theory concerning the multidimensionally of self-concept was developed by Shavelson and Bolus (1982) in their conceptualization of seven critical features of self-concept. They suggested that on the basis of different facets, self-concept may be distinguished both from academic achievement and academic self-concept. They also concluded from a study involving 99 junior high school students that academic self-concept is less stable than global self-concept and, therefore, may be changed more easily.

Academic achievement is moderately correlated with academic self-concept, and most highly correlated with academic self-concept in the same academic content area (Marsh, 1986). In a study on the cognition and

affective outcomes of disadvantaged pupils, Mevarech and Rich (1985) found that students who participated in a computer assisted instruction mathematics program rated themselves significantly higher on academic self-concept in mathematics achievement than students exposed to the same material in a traditional instructional setting.

The above findings raised the question of the extent that CAI would affect the academic self-concept and the basic skills mathematics achievement of black students endeavoring to pass the basic skills mathematics portion of the Education Entrance Examination. Would the students involved in CAI feel that CAI provided equal opportunities to all learners and that the success is within the control of each of them? Or do such students develop a dependency on the computer for checking responses and making decisions concerning one's own learning?

Review of Literature

Education Entrance Examination

The Education Entrance Examination (EEE) is the basic skills examination developed for prospective teacher education majors. In 1979, the South Carolina

legislature passed Act 187, providing "for a fair and comprehensive program for the training, certification, initial employment and evaluation of public educators in the State." The Act further intended that prospective teachers have basic reading, mathematics, and writing skills. The EEE was developed to meet the requirements of the legislation.

The EEE must be taken by all college and university students seeking admission to approved teacher education programs, including students who hold bachelor's degrees and are seeking admission for the purpose of obtaining initial certification. Passing scores have been established for the three portions of the EEE. Passing scores are reviewed periodically and may be adjusted to reflect changes in South Carolina's expectations for public educators.

To pass the EEE, examinees must pass all three portions. Anyone who does not pass one or more portion of the EEE may retake those portions. The number of times an examinee may take the EEE is specified by law. They may take the EEE no more than three times. The areas assessed by the EEE are writing, reading and mathematics. The mathematics portion consists of 56 multiple-choice questions that measure performance in

the domains of arithmetical concepts and operations, measurement, geometry and problem solving.

Computer Assisted Instruction

Drill and practice probably have been the most frequent uses of CAI Programs because they are relatively simple to implement and generally have been successful in improving skill levels. Burns and Bozeman (1981) found that CAI drill and practice were significantly more effective in promoting increased student achievement at both elementary and secondary instructional levels among students who were considered to be high achieving and disadvantaged. They found that achievement among average students was not significantly improved by supplementary enhanced drill and practice CAI.

Norton (1983) believed that inherent in the structure of a computer environment are cognitive processes for organizing and interpreting information which create habits of thought similar to the cognitive processes associated with creativity and problem solving. In the cognitive domain, the computer facilitates the traditional modes of instruction such as drill and practice, tutoring, and remediation.

In the affective domain, Weller (1983) described the computer as being private, patient, unangered, and bias-free, thus providing an excellent vehicle for students to examine their own value systems without detriment to their self-concept. Cox and Berger (1981) found that students who use microcomputers show positive growth in their attitudes toward school work, self-control, and tasks which involves problem solving skills. They believed that computers foster positive development of students' self-concept and promote growth through a sequence of nonthreatening challenges. Gallini (1983) suggested that CAI encourages a constant environment to motivate students toward more creativity, an opportunity seldom available in traditional methods. Basically, CAI is a learning structure that is interactive and individualized. Lesgold (1983) credited the computer's strength to being able to diagnose sources of student errors rapidly and access progress in their acquisition of skills.

Computer Assisted Instruction and Mathematics

This section contains research studies in which only mathematics achievement was linked to CAI. There is cumulative evidence that computers seem to provide an

effective means of improving performance in mathematics as well as a wide variety of subjects. Reviews in which CAI is summarized (Rapoport & Savard,1980) have all shown quite consistent positive effects on both achievement and attitudes. A growing number of these reviews relate to teaching mathematics to disadvantaged students (Lanese, 1983).

Bradtmueller (1983) summarized what is currently known about the positive and negative effects concerning CAI. Covering the period from 1975 to 1983, Bradtmueller indicated the following pros and cons of using microcomputers. Advantages of using microcomputers include the following:

1. highly motivating and encouraging,
2. helps prepare students for a computer world,
3. fosters independent study,
4. gives immediate feedback to students,
5. encourages individualization, and
6. nonthreatening.

Disadvantages of the use of microcomputers include the following:

1. too expensive to purchase and maintain,
2. require excessive time for teachers to

learn to operate,

3. there is incompatibility of software programs,
4. the forced multiple choice format requires no writing,
5. the software is poor and expensive, and
6. cost is often the major factor in the purchase rather than the program.

Shively (1984) found that deficiencies in basic mathematics skills could also be remediated at the secondary level using microcomputers. Another matter of considerable importance revealed in Shively's study was that previous microcomputers experiences have little impact on student outcomes. In fact, the trend seemed to be that those who had no computer experience did better than those who had them.

The literature relating computer assisted instruction to mathematics performance leads to the conclusion that a positive relationship exists. Also it seems that CAI is beneficial to some ethnic groups over others and that the degree of impact computers have on education in many areas of instruction is only beginning to be studied systematically.

Academic Self-Concept

Felker, Stanwyck, and Kay (1973) developed and implemented a teacher program, the primary focus of which was to enhance student self-concept. Two half-day training sessions were held to help teachers understand the fundamentals of increasing self-rewarding behavior of children. From the results, it can be suggested that teachers who increase self-rewarding behaviors of their students will also significantly increase the self-concepts of those students. Not only did these researchers confirm the claim that self-concept can be changed by increasing the self-rewarding behavior of students, but they also supported the claim that self-concept can be changed in the short-term, in this case 12 weeks.

Academic self-concept has also been studied as a dependent variable. Brookover, LePere, Hamachek, Erickson (1965) attempted to determine interventions which might enhance academic self-concept. They trained parents to provide positive communications with their children concerning school work and encouraged them to create an atmosphere which provided reinforcement for their children's positive statements about school. Students whose parents had the training showed a

significant, positive increase in academic self-concept as compared to students who did not have the training.

Kifer (1975) found that differences in academic self-concept are brought about by interactive outcomes with educational environments. These findings tend to support the idea that different teaching styles, modes of instruction, motivational factors, and types of feedback can have an effect on students' academic self-concept which, of course, in turn, may affect achievement levels.

Given the generally accepted proposition that higher self-concepts are desirable, it would appear that educational leaders have the responsibility to determine why academic self-concept changes, in what situations change is likely to occur, and in what direction it will change. Thus, examining changes in academic self-concept with regard to educational environments can result in educational leaders creating learning situations which will enhance the development of higher academic self-concept in students.

Research Questions

Answers to the following research questions were sought:

1. Are the adjusted posttest scores of the EEE

seminar students in basic skills mathematics significantly affected ($p < .05$) by (a) type of instruction (CAI vs. non-CAI), (b) sex (male vs. female), (c) interaction of mode of instruction and sex, (d) SES (high/low socioeconomic status), or (e) interaction of mode of instruction and SES?

2. Are the adjusted posttest scores of the EEE seminar students in academic self-concept significantly affected ($p < .05$) by (a) type of instruction (CAI vs. non-CAI), (b) sex (male vs. female), (c) interaction of mode of instruction and sex, (d) SES (high/low socioeconomic status), or (e) interaction of mode of instruction and SES?

Methodology

Subjects for this study consisted of EEE seminar students at South Carolina State College in Orangeburg, South Carolina. A random assignment of students using the CRC Handbook of Tables for Probability and Statistics (Beyer, 1987) was made. As determined from demographic information, black males comprised 43.0% (21) of the subjects, black females constituted 47.0%

(27) of the total group of subjects.

The research design used was the nonrandomized pretest-posttest experimental group design. The dependent variables studied were basic skills mathematics and academic self-concept scores. The independent variables studied were type of instruction, sex, and socioeconomic status of the subjects.

Forty-nine EEE mathematics seminar students, were randomly assigned to an experimental group and a control group. The students were given two pretests: a Basic Skills Mathematics EEE pretest and the Self-Concept of Academic Ability Scale (SCAA) (Brookover, LePere, Hamacheck, Thomas, and Erickson, 1965). Following administration of the instruments, the students in the control group participated in six weeks (18 sessions), 60 minutes per session, of EEE mathematics instruction. The students in the experimental group participated in six weeks (18 sessions) of CAI plus EEE seminar instruction in mathematics. Thirty minutes were CAI instruction in mathematics and thirty minutes were EEE seminar instruction in mathematics. The primary difference between the groups was that the experimental group received 30 minutes each session of CAI in mathematics. Upon termination of the six week

instructional period, students received posttests on measures of basic mathematics and academic self-concept.

The statistical technique used to analyze the data was analyses of covariance. Analysis of covariance was used to determine differences in adjusted posttest scores using the pretest scores as the covariate. Furthermore, it is a powerful statistical test with which to determine significant differences among groups. Posttest scores were analyzed for differences with regard to sex, type of instruction, and the interaction between sex and type of instruction, SES and the interaction between SES, and type of instruction. A subprogram of the Statistical Analysis System, version 5.08 (SAS, 1986) was used to calculate analysis of covariance.

Findings

Answers to two questions were sought. This section contains the results of statistical analysis of data obtained in regard to the two questions.

Question 1

1. Are the adjusted posttest scores of the EEE seminar students in basic skills mathematics significantly affected ($p < .05$) by (a) type of instruction (CAI

vs. non-CAI), (b) sex (male vs. female), (c) interaction of mode of instruction and sex, (d) SES (high/low socioeconomic status), or (e) interaction of mode of instruction and SES?

Analysis of covariance was used to determine differences in adjusted posttest scores using the pretest scores as the covariate. The posttest scores were analyzed for differences with regards to type of instruction, sex, the interaction between sex and type of instruction, SES, and the interaction between SES and type of instruction. There were statistically significant differences in adjusted posttest basic skills mathematics scores with regard to type of instruction (F = 28.51, p = 0.0001) and SES (F = 33.78 and p = 0.0001). There were no statistically significant differences in adjusted posttest basic skills mathematics scores with regard to sex (F= 3.78, p = 0.60), the interaction between sex and type of instruction (F = 2.12, p = 0.15), or the interaction between SES and type of instruction (F = 2.46, p = 0.12) (See Table 1).

Table 1
Analysis of Covariance for Posttest Measures of Basic Skills
Mathematics: General Linear Models Procedures

Dependent Variable: Math 2[a]

Source	DF	Sum of Square	Mean Square	F Value	PR F	R^2	C.V.
Model	6	3001.96	500.32	13.79	0.0001	0.66	14.53
Error	42	1524.15	36.28	Root MSE		Math Mean	
Corrected Total	48	4256.12		6.02		41.44	

		Type I				Type III		
Source	DF	SS	F Value	PR F	DF	SS	F Value	PR F
Group	1	1034.69	28.52	0.0001	1	569.32	15.69	0.0003
Sex	1	137.17	03.78	0.06	1	20.82	0.57	0.45
SES	1	1225.87	33.78	0.0001	1	05.75	0.16	0.6924
Group*Sex	1	76.78	02.12	0.15	1	28.24	0.78	0.38
Group*SES	1	89.42	02.46	0.12	1	69.39	1.91	0.17
Math 1[a]	1	438.01	12.07	0.0012	1	438.01	12.07	0.0012

[a]Math 2 is posttest mean and Math 1 is pretest mean.

Question 2

2. Are the adjusted posttest scores of the EEE seminar students in academic self-concept significantly affected ($p < .05$) by (a) type of instruction (CAI vs. non-CAI), (b) sex (male vs. female), (c) interaction of mode of instruction and sex, (d) SES (high/low socioeconomic status), or (e) interaction of mode of instruction and SES?

Analysis of covariance was used to determine differences in adjusted academic self-concept scores using the pretest academic self-concept scores as the covariate. The posttest scores were analyzed for differences with regard to sex, type of instruction, and the interaction between sex and type of instruction. There were statistically significant differences in adjusted posttest academic self-concept scores with regard to type of instruction ($F = 20.95$, $p = 0.0001$), SES ($F = 19.55$, $p = 0.0001$), and the interaction between SES and type of instruction ($F = 04.86$, $p = 0.03$). There were no statistically significant differences with regard to sex ($F = 02.03$, $p = 0.16$) and the interaction between sex and type of instruction ($F = 00.52$, $p = 0.47$) (See Table 2).

Table 2
Analysis of Covariance for Postest Measures of Academic Self-Concept: General Linear Models Procedures

Dependent Variable: ASC 2[a]

Source	DF	Sum of Squares	Mean Square	F Value	PR F	R^2	C.V.
Model	6	672.06	112.01	11.46	0.0001	0.62	10.84
Error	42	410.62	9.77	Root MSE		TASC Mean	
Corrected Total	48	1082.69		3.12		28.83	

		Type I				Type III		
Source	DF	SS	F Value	PR F	DF	SS	F Value	PR F
Group	1	204.77	20.95	0.0001	1	117.01	11.97	0.0013
Sex	1	19.83	02.03	0.16	1	0.81	00.08	0.77
SES	1	191.10	19.55	0.0001	1	1.79	00.18	0.6703
Group*Sex	1	05.06	00.52	0.47	1	6.62	00.68	0.41
Group*SES	1	47.51	04.86	0.03	1	4.56	00.46	0.49
ASC 1[a]	1	203.77	20.84	0.0001	1	203.77	20.84	0.0001

[a]Math 2 is posttest mean and Math 1 is pretest mean.

Discussion/Conclusions

Results of ANCOVA indicated that EEE seminar students exposed to the CAI mathematics program scored significantly higher in basic skills mathematics and academic self-concept than the students who were not exposed to the CAI treatment. The results provide evidence that low SES students increased their basic skills mathematics and academic self-concept scores as a result of participating in a seminar without CAI, whereas, high SES students neither increased nor decreased their scores significantly. The above findings are consistent with the majority of literature which indicated that CAI increased mathematics and academic self-concept scores for low SES students over traditional instruction.

Development of academic self-concept is partly a function of societal interaction; that is, it changes in response to how individuals are treated. From the existing literature it can be suggested that CAI is motivating and encouraging and provides a nonthreatening environment. There are other reasons why CAI may have a positive affect on academic self-concept. First, mastery of subject matter content and development of computer literacy may be potential sources of positive

affective development. Finally, the freedom from embarrassment, disapproval, and diminished status often accompanying a mistake in a classroom is reduced by the privacy of the CAI learning situation. This reduction in negative reinforcement allows the student to learn through trial and error at his or her own pace. Therefore, positive academic self-concept can be protected and enhanced.

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